AMENDMENTS TO THE SPECIFICATION:

Please amend the paragraphs beginning at page 3, line 26, and continuing to page 4, line 20, as follows:

An objective of the technology disclosed herein~~present invention~~ is to provide methods and devices for multi-user multi-carrier wireless communications system, which are capable to provide all users with sufficient pilots without causing unnecessary pilot overhead and pilot pollution. A further objective of the technology disclosed herein~~present invention~~ is to provide such methods and devices, which are easy to implement within present and planned wireless systems.

The above objectives are achieved by, e.g., methods and devices ~~according to the enclosed patent claims. In general words,~~wherein a set of different pilot structures are designed for use in different environments and/or different general radio characteristics that are expected to occur in the cell. The radio conditions for a user are estimated, either from direct measurements or from knowledge about the cell characteristics, possibly combined with position information. Each user is then assigned an area in resource space for its communication, which has a suitable pilot configuration. In one embodiment, the entire resource space is provided with different pilot structures in different parts in advance and allocation of resources to the users are then performed in order to match estimated radio conditions to the provided pilot structure. In another embodiment, allocation is performed first, and then the actual pilot structure is adapted within the allocated resource space area to suit the environmental conditions. For best performance, depending on such things as frequency selectivity, time selectivity (e.g. time dispersion and Doppler shift), and path loss the amount of pilot energy should be adapted and the 'distance' between pilots in the time-frequency domain needs to be changed.

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Please amend the paragraphs beginning at page 5, line 14, and continuing to page 5, line 29, as follows:

FIG. 4 is a flow diagram illustrating ~~an embodiment of~~ a method according to an example embodiment~~the present invention~~;

FIGS. 5A, 5B and 6 are diagrams illustrating pilot structures in time-frequency space, and the allocation of different users to subspaces according to example embodiments ~~of the present invention~~;

FIGS. 7A and 7B are flow diagrams illustrating other example method embodiments ~~of a method according to the present invention~~;

FIG. 8 is a flow diagram illustrating a part of a further example method embodiment ~~of a method according to the present invention~~;

FIGS. 9A to 9C are block diagrams of downlink radio management devices of network nodes according to example embodiments ~~of the present invention~~;

FIG. 10 is a block diagram of uplink radio management devices of network nodes according to example embodiments ~~of the present invention~~;

FIG. 11 is a diagram illustrating pilot structures in time-frequency space having different intensities, and the allocation of different users to subspaces according to an example embodiment ~~of the present invention~~; and

Please amend the paragraph beginning at page 6, line 2, and continuing to page 6, line 5, as follows:

In the following description, OFDM (Orthogonal Frequency Division Multiplexing) systems are used for exemplifying the technology disclosed herein~~present~~

~~invention~~. However, the technology disclosed herein~~present invention~~ can also be applied to other multi-carrier wireless communications systems.

Please amend the paragraph beginning at page 6, line 10, and continuing to page 7, line 4, as follows:

FIG. 1 illustrates a multi-user multi-carrier wireless communications system 10, in this particular embodiment intended to be an OFDM system. Non-exclusive examples of other communications systems, in which the technology disclosed herein~~present invention~~ is advantageously applicable, are IFDMA (Interleaved Frequency Division Multiple Access) systems, non-orthogonal or bi-orthogonal multi-carrier systems. A base station or access point 20 communicates with two mobile stations or user equipments 30A, 30B. There is a downlink connection 22A between the access point 20 and the user equipment 30A and an uplink connection 24A between the same nodes. Likewise, there is a downlink connection 22B between the access point 20 and the user equipment 30B and an uplink connection 24B between the same nodes. User equipment 30A is located at a relatively large distance from the access point 20, but the speed 32A (illustrated as an arrow) of the user equipment 30A is small. User equipment 30b is located closer to the access point 20, but has a high speed 32B (also illustrated as an arrow). The user equipment 30A may have a relatively high need for repetitive pilots in the frequency dimension, since the propagation conditions for the different carriers may differ considerably over the bandwidth in case of multi-path propagation with large delay spread. However, the radio conditions are probably quite slowly varying with time due to the small speed of user equipment 30A. The user equipment 30B is close to the access point, and a pilot on one frequency can probably be used for channel estimations for many neighbouring carriers. However, the radio conditions are probably changing rapidly in time, whereby frequent pilots in time dimension are required.

Please amend the paragraphs beginning at page 8, line 3, and continuing to page 8, line 14, as follows:

However, user equipment 30A now ~~achieves~~ encounters problems. This user equipment 30A moves slowly and is of limited use of the frequent updating in time. However, it has need for more closely located pilots in frequency dimension instead. The pilot structure of FIG. 2B becomes very unsuitable for user equipment 30A.

So far, only two dimensions, time and frequency, have been discussed. FIG. 3A illustrates a radio resource space in three dimensions, time, frequency and code. In such a system, each data quantity will instead correspond to a small cube 104. Generalisation can be performed to higher order spaces, comprising e.g. antenna or space dimensions. In general, any radio resource space in at least two dimensions, of which one is frequency, can be used with the technology disclosed herein~~present invention~~.

Please amend the paragraph beginning at page 9, line 3, and continuing to page 9, line 20, as follows:

The flow diagram of FIG. 4 illustrates the main steps of an example embodiment of a method- according to the technology disclosed herein~~present invention~~. The procedure starts in step 200. In step 202, a number of pilot configurations are provided, which are believed to suit different radio conditions appearing in the cell in question. At least two such pilot configurations are available, i.e. they can be handled by both sides of the transmission connection. At least one of the pilot configurations comprises sub-carriers having both pilot resources and data resources, i.e. resources allocated for any data not previously known by the receiver, such as user data, control signals or broadcast information, in order to accommodate efficiency requests from e.g. slow-moving terminals. The transmitter manages the sending of pilots according to this configurations and the receiver is capable of performing channel estimation based on the at least two pilot configurations. In step 204, an estimation of the radio conditions at the receiver is obtained. This estimation can be provided in many different ways. The actual radio

conditions can be measured and evaluated. Another possibility is to assume an estimate from knowledge about the characteristics in the cell and possibly based on e.g. location and/or speed of the receiver relative the transmitter.

Please amend the paragraph beginning at page 9, line 28, and continuing to page 10, line 5, as follows:

A few examples, using OFDM as an example system, will be used to visualise the effect of the technology disclosed herein~~present invention~~. The basic setup in FIG. 5A is assumed as follows. During a certain time period and seen over all frequency resources, the available radio resources constitute a grid of basic resources that can be used for data, control signaling or pilot signals or other signals as discussed earlier. The resolution in frequency dimension is one OFDM carrier and in time it is one OFDM symbol. Pilot symbols are as above depicted with hatched boxes.

Please amend the paragraph beginning at page 10, line 25, and continuing to page 11, line 6, as follows:

According to one example embodiment of the technology disclosed herein~~invention~~, the users are now allocated to the different parts of the radio resource space dependent on their estimated radio conditions. In other words, whenever a certain user has certain demands, the user is assigned resources in the resource space where pilots with the appropriate density can be utilised for channel estimation. In the situation in FIG. 5A, there are pilot structures suitable for typically four combinations of Doppler and delay spread. In part 110A, the pilot structure is intended for a large Doppler and low delay spread. In part 110B, the pilot structure is intended for a low Doppler and low delay spread. In part 110C, the pilot structure is intended for a low Doppler and high delay spread. In part 110D, the pilot structure is intended for a high Doppler and high delay spread.

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Please amend the paragraph beginning at page 11, line 25, and continuing to page 12, line 6, as follows:

~~In~~ FIG. 5B illustrates ~~,~~ a further example embodiment of the technology disclosed herein~~present invention is illustrated~~. Assume the same situation as was present in FIG. 5A. Three users are occupying all resources in the densest part 110D. ~~E~~ And yet if another user with need for a very dense pilot configuration appears, the pre-defined pilot configuration plan of FIG. 5A becomes insufficient. However, the new user can be allocated to a free resource sub-space 108F, preferably in connection with the part 110D. This sub-space 108F had originally a pilot pattern according to part 110C, but when allocating the user, the pilot pattern is adjusted to match the demands put by the new user. In such a way, the original pre-determined division into different parts in the resource space can be adapted to the actual need. However, if a good initial configuration is used, most cases are covered and the frequency of adjustments is low.

Please amend the paragraphs beginning at page 13, line 25, and continuing to page 14, line 16, as follows:

The technology disclosed herein~~present invention~~ can be implemented for wireless communication between any nodes in a communications system. Such nodes can be e.g. user equipment, mobile station, base station, access point or relay. In the examples below, the most straightforward situation with communication between a base station and a user equipment will be discussed as an example. The scope of the claims should, however, not be affected by this example.

Multi-carrier communication is typically most applied in downlink connections. In FIG. 9A, a wireless communications system according to an embodiment of the present invention is illustrated. A base station 20 communicates with a mobile terminal 30 via an uplink 24 and a downlink 22 connection. In the downlink communication, the ideas of the technology disclosed herein~~present invention~~ are implemented. The base station 20 comprises a downlink control unit 25, which is enlarged in the lower part of FIG. 9A.

The downlink control unit 25 is responsible for allocating resources for communication on the downlink 22 between the base station 20 and the mobile terminal 30 and comprises in turn a pilot manager 26 and a radio condition processor 28. Similarly, the mobile terminal or user equipment 30 also comprises a downlink control unit 35, also enlarged in the lower part of FIG. 9A. The downlink control unit 35 comprises a channel estimator 36 and a measurement unit 38 for radio conditions.

Please amend the paragraph beginning at page 16, line 22, and continuing to page 16, line 31, as follows:

FIG. 11 illustrates yet another <u>example</u> embodiment ~~of the present invention,~~ in which one makes use of the possibilities to vary the intensity to reduce pilot pollution. In parts 110A and 110D, all or some of the pilot data is marked to be transmitted with a lower (or zero) intensity. If a user equipment using the pilot signals is close to the base station, the transmission power does not have to be equally high to obtain a reasonable channel estimation compared with user equipments situated further away from the base station in such a way, it is also possible to vary the pilot intensity throughout the resource space. Such intensity configurations can as above be performed either in advance or as adjustment procedures.